

F.A.S. PUBLIC INTEREST

Formerly the FAS Newsletter

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CONTAINING
SAMPLE
EDITORIALS

THIS ISSUE:

SOVIET CIVIL DEFENSE

ARE WE THREATENED BY SOVIET CIVIL DEFENSE?

Evidently, there will always be among us those who reject the notion that deterrence is adequate. In the late fifties, exaggerated (missile gap) estimates of Soviet missile production led to fears that the U.S. retaliatory force of several hundred bombers might be destroyed. After 1,000 land-based and 656 submarine-based missiles were produced (and the gap exposed as a myth) the fearful turned to charging that the Soviet Union might be building an anti-ballistic missile system which — in concept if not in practice — might destroy in flight virtually all surviving U.S. retaliatory missiles.

We bought additional certainty in two quite different ways: MIRVing our missiles to penetrate any such defense and negotiating a agreement precluding significant anti-ballistic missile construction.

Now the same school of fear charges that the Soviet Union, with civil defense measures (especially city evacuation), might consider "acceptable" the destruction wreaked by several thousand (thousand!) nuclear warheads which, it is conceded, could not be destroyed in any Soviet first strike.

The Scenario Spelled Out

The complete scenario is rarely spelled out in detail, the better implicitly to overlook its problems. But it runs something like this: in a crisis, the Soviet Union evacuates all of its cities and then threatens to fire its missiles at our locatable forces (1,000 Minutemen missiles, tens of bomber bases, forward-based systems in Europe, etc.). Its leadership supposedly asserts that an evacuated Soviet population could rebuild the cities and industry destroyed by upward of 4,000 surviving American retaliatory warheads and, claiming that we could not, secures thereby some bargaining advantage.

Let us, at the outset, overlook the fact that the evacuation — which would take days, thereby alerting our forces — could only take place in good weather, and could only be maintained a short time, undermining enormously its value as a bargaining agent.

Let us overlook the fact that the engineering calculations of this school assume, among many other things, military discipline in movement, and in subsequent use of fallout shelters, by the entire population.

Let us also ignore the extreme difficulty of finding a crisis to which such apocalyptic methods, with their inevitable aftermath of coldest war, would be appropriate.

Above all, let us pass over the fact that the threat

could only be made once since — assuming general nuclear war did not erupt — the United States would subsequently leap into a Sparta-like frame of mind that would easily generate such weapons as would make any renewal of this threat quite inconceivable.

Let us, instead, address the ultimate Strangelovian fear. Is such a threat credible — that is to say, could such an attack after evacuation be rationally pondered by a political leadership?

The Soviet leadership, no matter how diabolically construed, would need assurances for the survival of the Soviet Union as a modern economic, social and political entity.

Nuclear attack planners would have to concede that virtually all of the Soviet cities and small towns would be leveled. They could not confidently predict that the surviving population, evacuated or not, would emerge from the first winter as a viable entity: medically, nutritionally, or economically.

With the population's disease resistance lowered by radiation, with related grim changes in the ecology (e.g., insects, are more resistant than mammals or birds to radiation), and with sanitation enormously disrupted, the survivors could be expected to suffer terribly and unpredictably from plagues and epidemics of all kinds.

With the survival of stockpiled Soviet grain surpluses uncertain, with chronic Soviet agricultural difficulties further exacerbated by fallout, with great uncertainty of supply of needed agricultural inputs, with the uncertainties of climate enhanced by worldwide weapons effects, and with the existing absence of world food reserves underlined by the absence of American food surpluses, high percentages of surviving Russians would likely starve.

Surviving Industry and Surviving Population

Economically, a certain ratio between survival industry and surviving population is obviously necessary; but this scenario postulates an enormous success in saving people with only scattered success in saving industry. MIRV having increased by a factor of ten the number of separate targets that the U.S. can strike, our targeting capability has greatly outraced any industrial dispersion program which Soviet civil defense planners might have envisaged. Thus these planners would have to project a society, overwhelmed with ill and injured, having to rebuild shelter for the entire urban population.

Under such strains, postwar economic viability

would be a question mark of real proportions. A great and sustained decline in numbers of population might go on for long periods before a steady state was reached years later in a stunted and completely demoralized society unrecognizable by present-day Moscow.

Not only medical, nutritional and economic integrity, but also political integrity is wholly beyond assurance. The loyalty of the border republics (Estonia, Ukraine, Latvia, Georgia) cannot be assured and the Soviet hold on eastern Siberia would be threatened by China. Far from taking over the world, the Soviet Union would itself risk dismemberment. The Eastern Europeans would, of course, seize the opportunity to assert their independence. Surviving nations everywhere would begin building their own nuclear weapons with a vengeance. Whatever parts of the world were not destroyed would be hard to subdue, especially with so little residual Soviet industrial and military capability.

It is wholly unnecessary to assume Soviet plans to run such risks to explain Soviet civil defense programs. In the first place, Western European states often reach the levels of expenditures per capita suggested for the Soviet Union and they are less clearly in the line of fire. For these states, it is wholly reasonable to conduct civil defense programs on a prudential basis — that war may occur, for whatever reason, is quite enough justification to maintain civil defense bureaucracies of some size. And the Russians have more reason than most to believe not only in war but in the possibility of survival against odds.

Civil Defense Against the Chinese?

In the second place, both the Soviet evacuation planning and the Soviet urban shelter program — between which the Soviet planners seem uncertainly to alternate — would be useful under certain circumstances against the Chinese. Just as we considered a “thin” ABM against the Chinese while rejecting as hopeless a “thick” ABM against the Soviet Union, so also could Soviet civil defense planners be considering, as effective in small nuclear wars, efforts which would be marginal in large ones. And, indeed, the rhetoric of the program, which often refers to “war-time production” being maintained and so on, is quite at odds with the alarmist notion that it would be used against a superpower like ours in an inevitably short war.

And perhaps most important of all, and never satisfactorily explained in these dark visions of the evacuation alarmists, is the reason why the Soviet Union agreed not to build an antiballistic missile system around its cities if it planned on threatening to launch and survive a nuclear war.

There are special dangers here to that same arms control agreement of real value negotiated so far: the ABM treaty. In particular, acceptance of easy nuclear war survival by means of evacuation could lead to a reassessment of city defense by anti-ballistic missiles either in the U.S. or the Soviet Union.

There are other costs to the insatiable urge for ever greater insurance against ever more absurd sce-

narios. It would be easy enough to move from that concept of totally “unacceptable damage” which we now call “assured destruction” to a concept of still more assured, still more total, destruction. We could, for example, build “dirty bombs” or thousands more warheads or something else. But can anyone believe that this would be the last move in the arms race? Can anyone doubt that the same preparations would be promptly made by the other side, to our increased peril?

Finally, whatever civil defense program is to be maintained in the United States, nothing could be more inappropriate, politically and strategically, than to cast that program — as these alarmists desire — in the context of a war-game response to a dangerous Soviet civil defense weapon.

Politically, it was a major and decisive error of Kennedy-era civil defense planners that their program was injected into the controversy surrounding the Soviet threat to Berlin. That history shows that no American civil defense program will be acceptable to the public except possibly on the prudential grounds that war might just occur and that, through civil defense, some lives might just be saved.

Strategically, if the Soviet program were to be really documented as undermining our deterrent — which is far from the present case — it would be absurd to recommend that U.S. civil defense could substitute, in redressing that problem, for reestablishing the deterrent.

What in the last analysis would “undermining our deterrent” mean? Need we go down that endless road of weapons aimed at proving that whatever Americans would survive the nuclear war would rebuild more rapidly than whatever Russians would survive? Or can we stop at some notion of “unacceptable damage”?

We are, today, as safe against calculated deliberate Soviet attack as we are going to get; only a desperate or an insane decisionmaker would undertake the risks at issue. To the insane decisionmaker we are already irrevocably vulnerable. What can be said about the desperate?

It can be said that politicians have already decided, in the nuclear age, that it is too dangerous to drive a nuclear power into a desperate corner. If, therefore, a Soviet civil defense program signals the undesirability of pushing the Soviet Union into a corner, then it merely signals something we already knew — and something the Soviet leadership already knows about us. Neither can be “rolled back.” Soviet desperation already had higher risks of producing unwanted war than its civil defense could ever provide of deliberate calculated attack.

We do not know where this debate will lead, or what evidence will be adduced that has not been provided thus far. But on the basis of everything in the public domain at this time, we feel obliged to warn our fellow citizens that exaggerations of the threat we face abroad have consistently led — through overreaction and weaponry spirals — to real diminutions in the safety of our Republic. □

F.A.S. PUBLIC INTEREST REPORT

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THIS ISSUE:

RECOMBINANT DNA

Vol. 29, No. 4

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PROMISE AND HAZARDS OF RECOMBINANT DNA RESEARCH: THREE SCHOOLS OF THOUGHT

Molecular biology has reached a stage that is brilliant with both danger and promise: the stage at which genetic material from one organism is being placed within another so that the inheritance of the host is changed to reflect the characteristics of the donor. Thus the genetic barriers between the species are being probed and, in a first few simple cases, surmounted so as to produce hybrid creatures.

Few doubt that this technology has the potential for deliberate misuse to produce great dangers. Genes from disease causing (pathogenic) organisms, or from organisms that produce highly toxic agents, could be implanted in hosts capable of rapid spread so as to produce dramatic new biological dangers. Not only common sense, but the biological treaty of 1972 to which the U.S. and 110 nations have become signatory, demands that scientists eschew development of such agents. Nevertheless, since treaties are nei-

ther universal nor self-enforcing, the world must begin to face a biological proliferation threat that might before long, rival that of nuclear weapons.

This new danger would, by itself, militate for a halt to this research were it not for the promise implicit in these techniques. Five percent of the population suffer from a few thousand different genetic diseases which may, in time, be amenable to future genetic engineering. The underdeveloped world lives in perpetual risk of famine; vast improvements in agriculture should be possible with genetic engineering of plants. A rising cancer rate already affects one person in four and these new techniques represent the single most important tool in many years for the investigation of the underlying, and hence highly relevant, biological processes. Ultimately, a more pre-

—Continued on page 2

SPLITTING ATOMS AND TRANSPLANTING GENES

With the first beginnings of practical genetic engineering, the biologists have begun to displace the physician in the spotlight of public concern. There is every indication now that society will have continuing and grave difficulties digesting biological advances.

With nuclear weapons, the danger was at least stark, and the solution clear: refrain from use of nuclear weapons. Deterrence now seems relatively simple. Genetic engineering, by contrast, begins with an unprecedented and worrisome problem: the accidental escape of organisms, unknown in nature and potentially, or even known to be, dangerous. It moves on to the problem of inadvertent by-products of biological successes as in the query: will the plants that are taught to fix their own nitrogen generate, somehow, a tenacious weed? Later, if we are sufficiently careful to avoid misusing this new power over the ecology, we may move on to solving cancer and the genetic diseases of man — and ultimately to the improvement of man. No doubt in certain cases, determining who will secure the benefits of these cures and, later, which, if any, improvements to strive for, will occupy the world's attention for generations.

Hovering over these problems of societal absorption is the clear danger of deliberate misuse, for biological weapons, of techniques that may rapidly proliferate not only to one hundred eleven nation states but even to individual researchers. In the nineteen forties many contemplated the danger of an unprecedented nuclear arms-race and concluded that the world would not survive the nuclear threat in a state of relative anarchy among nation states. One is tempted to reach the same conclusion again

in the biological arena—even while the first nuclear conclusion is still being perilously tested.

The researchers have behaved with unprecedented restraint and caution. Raising the issue themselves; bringing it to public attention; urging the voluntary deferral of various experiments; and debating the hazards in full public view, represents four quite different and thoroughly commendable steps. In addition, most have, quite surprisingly, been able to come to agreement on a set of guidelines that have grown steadily more stringent — even while many of the researchers have grown more sanguine about the dangers. This is a tribute to the statesmanship of their leaders. It is no surprise that now they want to go ahead with research which all observers agree is filled with promise, and which promises tremendous assistance in understanding biology. They only ask a "yellow" light — the right to proceed with caution.

However, some researchers and observers whose judgment FAS respects, still have different views on these matters. And despite intense thought by the molecular biologists, the issue does seem to have been considered somewhat unimaginatively thus far. The possibility that relevant creative ideas may yet exist impels us to request members to write expressing themselves on this problem.

FAS, founded by physicists, has worked for thirty years to control the implications of the fact that the atom could be split; now diversified to include many biologists, FAS pledges no less steadfast monitoring of the public policy implications of a fact no less far-reaching — the feasibility of transplanting genes. □

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cise knowledge of cellular processes would also permit a new attack on many other cellular diseases, ultimately, genetic engineering may hold forth the risky potential of improving man himself.

In order to achieve this promise, there will be required long periods of intensive work in many laboratories, in areas of biology in which there is necessarily great ignorance. As a result, the possibility of inadvertent creation of biological dangers cannot be dismissed. As the attached newsletter reveals, an unprecedented, constructive and wholly admirable effort to devise safeguards has been going forward among the researchers themselves since 1973. Notwithstanding the construction of a broad and impressive consensus among them, there remain significantly different approaches to this problem among equally informed molecular biologists.

The first school of thought either considers the proposed guidelines to be overly restrictive or has acceded to them reluctantly with the thought that the public would otherwise demand even more. This view considers inadvertent dangers wholly speculative and exaggerated. It sometimes fears restraints on free inquiry. It sees anomalies in the way in which other societal dangers, considered to be comparable, are tolerated — even such closely related dangers as the work by fellow biologists on known-to-be infectious organisms.

The second school emphasizes the speculative quality of the danger and believes that a system of regulating degrees of hazard by degrees of physical and biological methods of containment is both appropriate and feasible. (Biological containment involves developing strains of well-known organisms so enfeebled that they will not survive outside the laboratory should they escape at all.) This approach supports the guidelines. Along with many representatives of all three schools, it fears its proposals will be unreasonably perverted into more rigid regulations: difficult to amend; increasingly seen to have contradictions as research progresses; and, finally, destroyed by internal contradictions and quiet scientific revolt.

There is a third school that sees real danger in the multitude of things that might go wrong. This school is particularly disturbed that the experiment would use the widely studied *E. coli* bacteria which can live in the gut. By focusing their attention so singlemindedly on this organism, biologists have made headway in understanding fairly completely at least one species. But this organism, in which so much research has been invested, is now seen as far too ubiquitous, and promiscuous in exchange of genetic material for dangerous experiments. Is it sufficient to enfeeble strains that can live in man? Or should several years be spent working up the same degree of knowledge in some organism occupying a much more obscure ecological niche? In the meantime, or in general, this view often recommends that much more of this research be done in the kind of maximally secure laboratories previously for biological warfare experiments; more of these would be built.

This school sees no issue of "freedom of inquiry"

but rather "freedom of manufacture" of what might become public health hazards. It sees no great hurry in pushing ahead in areas where eventual successes will last forever. And it sees not only health hazards but hazards to sustained research if something should go wrong.

We have developed no consensus upon the two interrelated, critical questions of public policy: what degrees of precaution do public health and public confidence demand and how they can be achieved? Because the issue is so important, we believed that we must carry it to you in an effort to develop a consensus. We ask for reader comment by letter and through a ballot on page 9. □

— Reviewed and Approved by the FAS
National Council

FAS POLLED ITS MEMBERSHIP

Members were asked to indicate what they thought of the guidelines.

50% of non-biologists and 64% of the biologist respondents supported the guidelines. But 30% of non-biologist respondents and 25% of the biologists thought them insufficiently cautious. Five to ten percent of respondents thought the guidelines probably too restrictive. However, the response rate was not high and many members obviously have no strong opinion.

Our June Report carried this poll result and specific comments of some of the respondents on various related problems and possible solutions.

Do not hesitate to send your own reflections, whether or not you join or subscribe, because this issue is surely continuing and FAS's opinion is being solicited on it with increasing frequency. Be assured that we read and answer our mail, from whatever source.

"Closer association with the FAS confirmed my prior feeling that it meets the essential criteria of an effective organization: scientific objectivity in fact-finding analysis, and impartial but forceful presentation of evidence and significant goals." --

-- Edward L. Tatum (1909-1976), Nobel
Prize for Medicine and Physiology

F.A.S. PUBLIC INTEREST REPORT

Formerly the FAS Newsletter

THIS ISSUE:

PROLIFERATION

Vol. 29, No. 8

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PROLIFERATION: WHAT CAN AND CAN'T BE DONE

The campaign against nuclear proliferation has passed through two stages and is organizing itself for a third and fourth. In the beginning, the campaign was based on keeping the "secret" of the bomb. When the secret no longer could be kept, a political bandwagon — the non-proliferation treaty — was developed to dissuade the undecided.

Now the momentum of the bandwagon is spent. Many not participating in the treaty presumably either see a potential security requirement for nuclear weapons (Taiwan, Pakistan, Israel) or anticipate a desire to exploit them for political purposes (Brazil, Argentina). Probably none of these can be persuaded to forego nuclear weapons by political sleight of hand. Indeed one worries about the ultimate intentions of such signatories or parties to the treaty as South Korea, Egypt, and Iran.

Nor can these countries be prevented or even seriously delayed from building nuclear weapons by embargoes of material or technical knowledge. For a fraction of the cost of building nuclear power reactors, they can, as did the Indians, construct a reactor designed to produce plutonium and a small reprocessing plant and gain, thereby, the means for a few bombs.

What card remains to be played? A possible key lies in observing that the proliferation of nuclear powers has been far slower than was anticipated in the fifties and sixties. Studies of that period focused on the technical capability to build a bomb and assessed correctly that tens of nations in the seventies could do so. But today only six or seven states have nuclear weapons. With the spread of nuclear reactors, the lead-time toward the building of a bomb is being still further reduced and the technical obstacles further diminished. But, as before, it remains true that

a power must not only be able to do so but be determined to do so.

The influencible question therefore lies in what "determined" means. It is an error to continue to underestimate the political determination required because it leads to overlooking our ability to influence that motivation.

In the first place, nations must determine that nuclear weapons are relevant to their military and/or political needs. Few can make that determination. Since they are rarely going to build their weapons secretly — and never can assure such secrecy — they must anticipate bomb construction by neighbors. Will their situation be improved on balance? They must defend securely the bombs they build, not only against neighbors or military attack but against terrorists and political insurgents. Can they do so without lingering doubts? In principle, many nations should determine that, overall, the construction of a nuclear force will do them more harm than good.

America and like-minded nations can influence that calculation. They can attempt to deter new nuclear powers. In America's case, especially, we can threaten a review, with prejudice, of our economic aid and military security arrangements with any nation building nuclear weapons. The review is justifiable quite apart from its deterrent effect because each new nuclear power raises itself the issue of whether it continues to require security assurances. Indeed, providing security guarantees to nations that can precipitate nuclear wars can be dangerous to the guarantors. Providing economic help to nations embarked on an expensive program to main-

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—Reviewed and Approved by the FAS Council

PROLIFERATION PRESSURES: THE THREE SHOCKS

Thus far, all things considered, a remarkable success has been achieved. Thirty years after World War II revealed that atomic bombs could be made, only the Post-War Big Five are nuclearly armed, plus a device in India and possibly some weapons in Israel.

But three shocks are coming in rapid succession. On the whole, it should be possible to limit the first shock — commercial power reactors that burn nuclear fuel — to the spread of the reactors themselves without attendant enrichment plants and spent fuel reprocessing plants. But this is only because neither of the latter are really economic.

The second shock would occur if power reactors that

bred nuclear fuel were to spread rapidly since they require the reprocessing of spent fuel and the accumulation of large amounts of plutonium.

The third and final shock would occur if cheap methods arise of creating bomb material without the use of reactors. Direct enrichment of uranium to bomb-grade levels of U-235 by lasers, for example, would eliminate the entire Rube Goldberg process of: a) slightly enriching uranium; b) burning it in a reactor and converting part of the U-238 to plutonium; and d) separating out the plutonium in a reprocessing plant and making plutonium bombs.

Time is running out; the world must get its house in order. □

tain a nuclear strike force raises serious questions also.

Can the United States justify vigorous efforts to prevent others from achieving its own nuclear status? We do not believe that the excessive American nuclear stockpile disqualifies America from pressuring others to desist. No organization has emphasized more often than FAS the importance of great power restraint in the arms race. But international order and security is only further imperiled by new nuclear powers.

To effectively deter nations from going nuclear, the United States will have to make credible the threat of an aroused reaction. On the practical level, this credibility would be increased by U.S. attention to the detail of problems of nuclear theft, to the strengthening of safeguards, and to such injunctions against the sale of reprocessing and enrichment plants as are embedded in the Symington amendment to the Foreign Assistance Act (See p. 4).

In particular, we see no need and much possible harm in the sale of reprocessing plants to non-nuclear powers in the next decade. Reprocessing and recycling of spent fuel is not now economic even for nations with many nuclear reactors, much less for those with a few. It does not free reactor buyers from dependence upon a supply of new enriched material. And an ample supply of enriched material for export seems easily assured for the next two decades. We believe that no legitimate need for the proliferation of reprocessing and enrichment plants exists. Relevant requests are, instead, warnings of a likely intention to build nuclear weapons.

This is simply not the time to institutionalize, in our country, or abroad, methods for reprocessing and recycling plutonium. The worldwide reactor industry is having birth pains. And these are unrelated to plutonium recycle considerations. Why not wait until the dimensions of the need for uranium are clearer, and the prospects for the breeder are clarified? Without precluding the development of working demonstration plants by nuclear suppliers, we urge that, with regard to plutonium recycle, the world should "hang loose for a decade." In particular, the Nuclear Regulatory Commission (NRC), scheduled to reach a decision in 1977 on domestic recycling, should report adversely.

It is often argued that restraints on reprocessing and other relevant nuclear technology "buy time." In fact, their effect can be expressed more precisely and seen to have more significance still. The present goal of non-proliferation efforts is to preclude a self-fulfilling tendency in which many nations build weapons on the assumption that others are about to do so and, hence, that they themselves might as well do so too. If this mob psychology can be opposed and slowed, it is by no means impossible to imagine a largely non-nuclear world co-existing with the spread of nuclear-bomb-related technology. After all, our ultimate protection against such other means of mass destruction as biological and chemical weapons is not envisioned as a slowing of the relevant technology.

It is not quixotic to work for a world with ever

fewer conflicts to which nuclear weapons are militarily relevant. Already today only a limited number of nations fear military destruction or military take-overs by their neighbors. Insulating these hard-core cases from nuclear threats, if not resolving the conflicts, is an entirely plausible strategy and hope. Other states may then ultimately lack the motivation to jump the non-nuclear traces.

Thus the present goal of non-proliferation efforts is to ensure that the shock waves produced by the current spread of nuclear reactors do not cause nuclear-tending nations to bolt into nuclear status. Slowing the dissemination of reprocessing, and pressuring nations not to go over the edge, may not succeed. But it provides prospects of success wholly ample to justify a serious effort. □

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F.A.S. PUBLIC INTEREST REPORT

Formerly the FAS Newsletter

THIS ISSUE:

SCIENTIFIC RESPONSIBILITY

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TO WHOM ARE PUBLIC INTEREST SCIENTISTS RESPONSIBLE?

"Scientific responsibility" has, in practice, two quite different and partly opposed meanings. The supporters of these different interpretations are often quite innocent of any realization that the other interpretation exists. Thus an unholy alliance advances the bare notion of scientific responsibility. But certain attempts to apply the concept risk the outbreak of open warfare between the two schools.

The problems arise with regard to the participation of scientists in the public debate. On matters within the scientific community, there is no important difference in point of view among scientists on what constitutes scientific responsibility. All oppose such traditional forms of scientific irresponsibility as falsification of data, plagiarism, suppression of opposing points of view, etc.

The underlying question at issue is whether the traditional notions of scientific responsibility, developed within the community, can cope adequately with the entirely different problems posed in the interface between science and the public. At the heart of the difference in perspective is the question: "responsibility to whom".

Responsible Conduct Seen as Issue

The narrow school of interpretation prefers to use the concept "responsible conduct of scientists" as its interpretation of the phrase. In its view, the "responsibility" at issue is a responsibility to the scientific community: not to demean the community or to diminish the standing of colleagues, by acting in ways dissonant with the traditions of science or its popular image. It sees improper actions as threats to the integrity of science and, sometimes, even to its funding.

In particular, this school often considers it vaguely or flatly irresponsible to make public assertions which are imprecise or, worse, unprovable; to generalize

without firm grounds; and/or to speculate. It is often considered questionable: to advocate policy decisions that involve science but go beyond it; to campaign for such policies; to ally oneself with non-scientists in such campaigns; to accept the undignified and inadequate conditions for presentation the media often require; to go "over the head" of the scientific community; and so on.

A broader interpretation of scientific responsibility conceives it primarily as a responsibility to society rather than to the scientific community; this school of thought prefers to use the phrase "social responsibility." It has acquiesced in the fact that virtually all arguable policy decisions inevitably go beyond science. It accepts as inevitable that scientists involved in public debate will have to go beyond discussing what is scientifically known for certain. In its view, the name of the public policy game is decision-making under enormous uncertainties; what is known for certain is usually uncontroversial and needing no exponents.

Perhaps the most important difference between these two interpretations of scientific responsibility is that the narrow view implicitly discourages involvement by scientists in public debate, while the broad view instructs them that such participation is their "social responsibility."

Let no one minimize the importance of this difference in perspective. At issue is the degree of participation in the public debate of hundreds of thousands of the most intelligent citizens in America, individuals whose special training and knowledge makes them especially well-suited to objective analysis of the issues in and around science.

—Continued on page 2

—Reviewed and Approved by the FAS Council

MEMBERS INVITED TO COMMENT ON SCIENTIFIC RESPONSIBILITY

Scientific responsibility is hard to define. And it is harder to practice than preach. But nothing is more important to FAS than an investigation of such issues; with the help of our members and others, we plan to turn our attention to this subject from time to time.

This preliminary discussion ponders the differences in meaning which "scientific responsibility" has in the ideological camps of other nations as well as the differences of view in our own debate. In a subsequent *Report*, later in the academic year, we plan to go somewhat further by

discussing hypothetical but concrete vignettes to give substance to a discussion that is otherwise unworkably abstract.

We ask our readers to send us their reflections. What are the key issues of scientific freedom and responsibility? To whom is responsibility due? What kind of freedom is meant? Where are the contradictions between the different meanings? And what practical conclusions should FAS draw? Send your relevant complaints also — about FAS as well as others — and your commendations. □

Continued from page 1

Standards

The central issue is how standards of responsibility in public communication should be maintained.

There should be standards. We do believe that scientists should hew to a higher ethical standard than that which need be obeyed, for example, by politicians. Scientists should: avoid dogmatism; make their assumptions as overt as they can; qualify their remarks as well as conditions permit; be willing to surface, recognize, and admit weaknesses in their own argument; be ready to reason with those who disagree; and, in general, behave in a civilized fashion.

What we doubt, however, is the ability of professional scientific organizations to monitor and maintain these standards. Scientists involved in the public debate confront problems totally unfamiliar to these traditional organizations: unusual media conditions; the necessity to work from inadequate sources; enormous uncertainties about facts; pressures of time; tactical decisions concerning allies; controversies mixing values and facts; and many others. As a result, the traditional professional society really has no consensus, and hence no standing, with which to determine whether a scientist met his obligations to the public in a praiseworthy or censurable fashion. These are not questions of referees, of publication disputes, of methods of scientific argumentation. These are problems far more unruly.

Another method for maintaining standards is no better. This is the model known to lawyers, doctors, and engineers; these disciplines have codes of professional responsibility designed to monitor interactions between their professionals and the public. But codes of this kind have not worked well, often degenerating into self-serving efforts to protect the marketability of the scientific technology at issue. And, in any case, no formal code can resolve the multidimensional aspects of dealing with real problems in a real political world.

Marketplace of Ideas

What is left? In the first place, in the public arena, for the most part, the solution to poor analysis and scientific distortion is better analysis, and critiques of that distortion. In this sense, the solution to the involvement of scientists whose views or behavior one regrets is one's own involvement. We believe that, in the clash of scientific interpretations and opinions, those who apply the scientific ethos tend to prevail because those who apply that ethos most steadfastly enhance their credibility over time both with other involved scientists and with the public.

Moreover, in America, we have some faith that the societal methods of monitoring the public debate will be generally adequate to control scientific contributions just as they absorb the specialized contributions of many other kinds of experts. A competitive market place of ideas — including, of course, criticism by fellow scientists — will keep the discussion relatively honest.

To the extent to which the free market of ideas

fails, it will be necessary for those scientists who are themselves involved in the public debate to evolve their own standards. Public interest scientists should have the right to be judged by their peers — by others who have run the societal gauntlets involved; by others who have appraised the options available. Through their own peer-group pressures — and their public service awards — scientists involved in public debate will provide role models for each other.

In sum, the solution to the interminable dispute over scientific behavior in the public arena is not to be found in merely repeating what scientists have preached as responsible conduct inside science but in what they come to practice collectively as social responsibility outside science. □

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cluded the President of the Academy of Sciences of the German Democratic Republic, the Nobel Prize-winning developer of the laser (with FAS's Charles Townes), and a Soviet Academician on the Presidium of the Supreme Soviet.

In order to get the Home Office moving, Professor Burhop was enlisting the help of Members of Parliament whose Labor Party affiliations arose through association with the British affiliate of WFSW. This affiliate was the ASTMS—Association of Scientific, Technical, & Managerial Staffs—a union of about 370,000 workers of which 20,000 are scientists. Thirty-five Members of Parliament, including, I was told, Harold Wilson, are so affiliated with this seventh largest British trade union.

Professor Burhop allowed that he would rule out of order any resolution that specifically attacked the British Government over this issue. Apparently WFSW never attacks its hosts, and also the responsibility for the problem was clouded. It was decided that the British representatives present would call on the Home Secretary first thing Monday morning.

Mongolians Remembered an FAS Approach

At the coffee break, I approached the Mongolian delegation: Mr. Y. Ganbold, a tall and pleasant interpreter of both English and Russian, and Mrs. Indra, a biochemist. I described earlier FAS efforts in 1972 to get in touch with the Academy of Sciences of the People's Republic of Mongolia. To my surprise, Mrs. Indra said she had seen "in another institution than her own" the multi-volume bibliography on wheat which FAS had sent as a token of our interest in exchanging views. Speaking carefully and gently, she said that the conversation we were having could be considered a "first step" in opening relations between our organizations.

Subsequently, I introduced myself to the only representative present from the East German delegation, a historian, Professor G. Heidorn. He had apparently been a President of the International Congress on the History of the Press. I wondered what on earth would be an East German assessment of the history of the freedom of the press.

I also met two more observers: L. B. Balant, who represented several hundred scientists in the Swiss Association of Young Research Workers; and Dr. Daltaban, who represented the 5,000-member Turkish Student Federation in Great Britain. Later in the meeting, Dr. Daltaban denounced the Turkish Government for (a) 150 political murders in the last 1½ years with the murderers still at large and (b) mistreatment of thousands of political prisoners, including especially eminent translators and scientists. The March 12, 1971 intervention of Turkish generals, he said, had led to hundreds of scientists being arrested. One reactionary MP in parliament had shouted, "in order to stop anarchy, all of the professors and teaching staff must be killed." Scientists were being repressed, prevented from organizing, and forced to immigrate. I made a mental note to try to figure out upon my return what, indeed, was happening in Turkey.

The coffee break was extended because the French delegation was still caucusing. When the French were ready, they expressed concern that the visa problem might set a precedent that would restrict meetings of the WFSW to socialist countries. They proposed that the meeting con-



Professor Eric Burhop, F.R.S.
President, WFSW

FAS

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F.A.S. PUBLIC INTEREST REPORT

Formerly the FAS Newsletter

THIS ISSUE:

CANCER & THE ENVIRONMENT

Vol. 29, No. 5

May, 1976

CANCER: ATTENTION IS TURNING TO PREVENTION

Fashions change in the world of cancer theoreticians. In the forties, there was intense interest in radiation as a cancer-inducing mechanism (carcinogen). Later, in the fifties and sixties, viruses became the prime suspect. Now chemical carcinogens are emerging as the focus of attention. What lessons should the public draw?

The perspective that we live in a sea of dangerous radiation has saved many lives. Radiation can indeed cause cancers, and dangerous mutations as well. No one doubts the desirability of the caution this view impelled in the use of radiation.

The analogous view that we live in a sea of cancer-inducing viruses has thus far been disappointingly unproductive of public health implications. Decades of intense research, and many hundreds of millions of dollars, have left viral researchers backpeddling. While viruses have been shown to cause an array of cancers in small mammals, none has yet been unequivocally shown to cause cancer in man. Theories that viruses carry into man's chromosomes a cancer-causing gene (oncogene) are being shaded into theories that these genes were left there by viruses much earlier. It becomes increasingly difficult to determine how some variants of such theories could even be tested, much less to deduce from them some method of protecting the public. The underlying hope of viral cancer specialists had been, of course, to pro-

duce a vaccine against the virus; this hope is presently in retreat.

Fortunately, the third view that we live in a sea of potentially carcinogenic chemicals has — as did the view concerning radiation — some useful implications for public health. Chemicals can and should be tested for their carcinogenicity and, to the extent that circumstances permit, man should avoid contact with those that cause significant numbers of cancer. This means a strong toxic substances bill requiring pre-market testing of the thousands of new compounds that pour onto the market each year. And this, in turn, requires the validation and adoption of testing methods that can inexpensively, quickly, and reliably screen these chemicals. Fortunately, there is timely hope that the Ames test — which correlates carcinogenicity in mammals with mutagenicity of the bacterium *Salmonella Typhimurium* — will provide such a screen. Nothing could be more important at present than to validate this test. (See page 6.)

We do not wish to overstate the promise of the environmental chemical approach to cancer if only because cancer is a graveyard of such hopes. It is true that, increasingly, many observers now consider cancer to be 70%-90% environmentally induced. Epidemiologists observe that a reduction of the U.S. cancer rate for each cancer to the lowest rate observed

—Continued on page 2

CANCER: RUNNING THE GAUNTLET FOR TWENTY-FIVE YEARS

... In recent years, it has become clear that only by preventing disease from occurring, rather than treating it late, can we hope to achieve any major improvement in the nation's health. [Heart disease, cancer and stroke] are caused by factors (e.g. the environment and individual behaviour) that are not susceptible to direct medical solution."

—HEW Forward Plan for Health, 1977-1981

So far we have been lucky. The perennial rise of 1% in cancer mortality for the last forty years can be attributed to earlier dramatic increases in smoking with a subsequent rise in lung cancer. Thus the only important carcinogen to which we are known to be societally addicted is cigarettes. But since cancer mortality reflects the environment of twenty or thirty years ago, we have only just begun to experience the results of the post-World War II surge in chemical production. Is the asbestos in the brake-linings of the post-war flood of automobiles contributing synergistically to the lung cancer caused by smoking — as it does so dramatically in the lungs of smoking asbestos laborers? No one knows. And

among the hundreds of thousands of new compounds produced in this post-war period, there is room for a great many surprises; virtually none have been tested for their cancer-causing qualities.

If a toxic substances bill passes this year, then — if we survive without disaster to the year 2000 — we will finally be able to (excuse the pun) breathe more freely. It will have been a miracle not to have run across one, much less several, widespread and highly carcinogenic substances in the constant chemical reshaping of our environment over the last thirty years.

Without this bill, the Government approach to cancer prevention can only be described as chaotic and laggard. HEW's NIOSH (National Institute for Occupational Safety and Health) has a list of 1500 substances for which the literature demonstrates some carcinogenic activity. NIOSH has been in existence for many years in one form or another but has drafted its "criteria documents" for only two dozen of these substances, of which most resulted from the requirements of a single suit brought

—Continued on page 3

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LET THE VOICE OF SCIENCE BE HEARD

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Cancer and the Environment	Helsinki Accord & the Soviet Scientist	Recombinant DNA
First Use of Nuclear Weapons	Visit to People's Republic of China	

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